lowest order bit transparent segment

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed description]
[0001]
[The technical field to which invention belongs] this invention relates to a video-display system, especially the video-display system which uses a space optical modulator.
[0002]
[Object of the Invention] The space optical modulator used for a video display generates an image by controlling eve one and two or more elements of each for every pixel, i.e., pixel, in the last image typically. These systems have som clear properties which need a new research study about dealing with an input video data. The conventional cathode-r tube (CRT is called hereafter) system has a nonlinear response between the brightness perceived by the voltage and observer of a signal. It is required although one factor which influences this is **** (phosphorus) used on the screen almost all CRT system and these ******s have a nonlinear response, however in order to generate a color. A color w be controlled by light which irradiates the screen front face of CRT system if a space optical modulator is used. The light which illuminates each element already wears a certain color by whether the color filter of the white light sourc and a certain form is used, or the tinction light source is used. It can come, and comes out, with a nonlinear response the conventional CRT system is removed.
[0003] It is necessary to carry out the "reverse gamma" of the video data for the linearity of a space optical-modulato system. Since CRT system has spread very much, the gamma amendment and ********** to the nonlinearity of t system already incorporated into this signal path are given to the video signal. In the case of a linear system like a space optical-modulator system, you have to remove this amendment.
[0004] A problem happens to the property of almost all the space optical-modulator system. These systems operate b PDM (PWM is called hereafter) typically. An input data signal becomes the sample which is digitized and has the bit of a predetermined number for every pixel. It depends for the value for every bit of a sample on the perceived brightness to the pixel in the frame. the most significant bit (MSB is called hereafter) -- about -- it is displayed during 1 / 2 color segment time Color segment time is equal to what divided frame time by 3, and, so, each color, i.e., red, green, and blue have one third of frame time. Frame time is the time relevant to each image frame of an entering signal. In the case of 60Hz system, frame time is 16.67ms. Since a standard CRT system is the speed which writes in an image on the screen, this also calls it a display refresh rate.
[0005] Since an operation of PWM is too quick for an eye sensing change, an eye perceives all color picture images, and an eye integrates with brightness and a color over a time frame.
[0006] The following MSB has one half of 1 / 2 color-duration segments of previous MSB, namely, it has one fourth color duration **********s, and a least significant bit (LSB is called hereafter) is displayed at last like the following. It depends for the width of face of LSB on the minimum spacing which can be attained. For example, the element can be switched and displayed on within a time [with a modulator shorter than 40 microseconds], and if the s nothing, LSB time cannot become shorter than 40 microseconds.
[0007] However, in order to simulate completely a response of CRT which operates by 60Hz display refresh rate, i.e. frame time, the system needs the bit with more data than 8 bits. The space optical modulator with LSB time when it i equal for 40 microseconds cannot attain many from 7 bits per color segment. Consequently, in addition to the low simulation of CRT system, the artifact which is not desirable as for some is produced. To the low-strength field in an image, a small number of bit produces the ********** ring artifact. Furthermore, "dirt" ****** and the data compression artifact are strengthened for a dark field. Probably, these problems are removable supposing it operates system so that many bits may be used from per sample using a certain technique of operation.
[0008]

The means for solving a technical problem] this invention offers the system and technique for the display by which he video image has been improved. The color wheel or VCF equipped with a neutral density filter (NDF is called ıereafter) for every color is used for this system. NDF to each color enables it to display the longer bit in a time nterval, and conquers the limitation which is a certain minimal dose of the time to a display of a lower bit.
0009] if the advantage of this system generates the image in which this system also adjusts closely the image deer vhich enabled it to use many bits from per sample in a display image, and lessened the artifact with the image of the conventional display system -- **** -- they are things
0010]
Gestalt of an example] In the conventional PWM system, MSB receives one half of color segment time. Color segment time is [every / 3 / 1// of each frame time] at a type for every 1/3 of frame time, i.e., red, green, and blue. In he case of 60Hz system, frame time is 1 / 60 seconds (i.e., 16.67ms). This 60Hz speed also calls a display refresh rat and this originates in the write time of CRT system. Consequently, it is 0.01667/3ms, i.e., 5.56ms, therefore the color segment time for 5,560 microseconds is produced again.
0011] As for the case of the color wheel system which uses a color wheel equipped with red, green, and three equivalent blue segments, this time must contain spoke time. Spoke time is such time that the spoke of the wheel between colors passes through a light source front. This time must include such time and the response time of each element of a modulator in loading data to the addressing electronic circuitry of a modulator.
0012] As an estimate, Table 1 can be made for 5,560 microseconds using a system, and the time assigned for every effective bits is shown to the 8 bit system by which this table sets a bit 7 to MSB, and sets a bit 0 to LSB and which uses the conventional PWM.
0013]
Table 1]

ビット	時間決定	時間上限 (μs)
MSB (ビット 7)	< 1/2 色セグメント時間	2780
MSB-1 (次の MSB,ビット6)	< 1/4 色セグメント時間	1390
bit 5	< 1/8 色セグメント時間	695
bit 4	< 1/16 色セグメント時間	348
bit 3	< 1/32 色セグメント時間	174
bit 2	< 1/64 色セグメント時間	87
bit 1	< 1/128 色セグメント時間	43
bit 0	< 1/256 色セグメント時間	21

0014] therefore, 40 microseconds and **** -- in the case of the modulator which has the shortest time [like], many cannot be displayed from 7 bits of data For 21 microseconds, an element cannot reset to new data, the following data cannot be received, and sufficient time to reset to this new data cannot be given. One example of the modulator whicl has such a limitation is shown in drawing 1 .
0015] Drawing 1 shows the side elevation of a modulation element 10 known as a digital mirror device (DMD is called hereafter). The mirror 20 is stable in the horizontal position, and is supported by the beam 16. When addressin of the mirror 20 is carried out by address electrode 12b, a mirror 20 inclines until it carries out seat arrival of the one side to landing electrode 14b and takes position 22a. After time for the bit about the mirror 20 of data to have passes, mirror 20 is reset, namely, can give the signal which makes a mirror 20 answer new data. For this argument, data assume that position 22a is taken by the mirror 20, and a mirror 20 is ON if it is ****, as discussed upwards. The ligh from a mirror 20 reflects in the field which forms an image in Scone or a front face.
0016] after a reset signal and new data are ON signals -- if it becomes, this returns a mirror 20 to position 22a, or the s a new signal off -- if it becomes, a mirror 20 will be made take position 22b in that case Position 22b is attained by carrying out addressing of the address electrode 12a, and carrying out seat arrival of the mirror 20 to landing electrod 14a. it is desirable that a mirror 20 takes an opposition in an off position rather than maintains a horizontal, and this akes an opposition -- with, it is because it prevents that a hinge inclines eternally towards on position and big

elongation is placed between the ON path in an optical system, and an off path
0017] However, there is mirror 20 response time relevant to movement of a mirror 20. the mirror 20 to which this esponse time is called a certain time interval, i.e., mirror flight time, takes a new position -- being such -- about 10 nicroseconds is usually required This response time is time to limit the amount of the minimum time which will not ecome if it comes to be allowed within LSB time. Similar limitation is imposed on other modulators other than DMI y those response times. Limitation similar about the mirror movement is imposed on a ********** mirroi levice, i.e., AMA. In order to turn a cell on and off, you have to give time to twist to a liquid crystal cell.
0018] However, the technique and the system which enable it to process many bits within color ********** time xist. It helps to help for an extra bit to remove the artifact of a low-strength contest ****** ring, and a "dirt" **** ield per [which can be used for a system] sample, and to simulate a continuity on-the-strength response better.
0019] The limitation imposed on a system is the minimal dose of the time which can be used in order to display LSE roper. Therefore, a limitation will be applied supposing there is the technique of lengthening LSB time. However, supposing it uses a standard concentration color wheel, lengthening LSB time makes a picture image change.
0020] When a color wheel contains a low concentration segment in each color segment, LSB time can be extended nd it enables it to use many bits by every data sample. The example of this color wheel is shown in drawing 2 .
0021] The color wheel 30 has three segments and each of these segments has 120-degree arc-length thetaCS. Each rc-length thetaCS is short arc-length thetaNDF. NDF is included. For example, thetaNDF from which one arc-lengtl hetaCS adds NDF to the main color segment 32 and blue which are blue, and is obtained It is included, the low concentration blue segment 34, i.e., NDF segment, of a length. in order to make the NDF segment 34 possible, it is nversely proportional to the concentration of the NDF segment 34 in the time to the lower bit, and is made long -- if icks, it will not become A high order bit is the conventional PWM, with is modulated.
0022] The example of the timing diagram to PWM (NDF and PWM are called hereafter) system using NDF is show n drawing 3 . It is the time t0 whose timing diagram is the beginning of MSB in the case of a standard PWM system. starts. MSB -- time t1 up to -- it is displayed between the conventional time width of face for about 2,780 nicroseconds PWM is almost the same respectively to the termination of a bit 0 in time t6 between two diagrams to a standard PWM system, and NDF and PWM system.
0023] however, time t7 which is the length as bit 0 hour with the same extra bit by the diagram to NDF and PWM system **** -- t8 up to -- although displayed between time width of face, the intensity of the segment to this bit is 50 of only an intensity of the main color segment 32 of the color segments By making an intensity into a half, displaying he bit for a long time twice is allowed. Therefore, the time in NDF and PWM system for 8 bits becomes long only fc 43 microseconds. extra 43microsecond -- in order to use it, you have to fit other bits in the system to this
0024] The time to these lower bits multiplies the ratio of the intensity of the main color segment 32, and the intensity of the NDF segment 34 by the conventional PWM time. For example, the time to 8 bits of upper ** is 43/2 nicrosecond, i.e., 21.5 microseconds. The intensity ratio to the NDF segment 34 of the main color segment 32 is 2:1 the intensity of the NDF segment 34 is 1/2 of the intensity of the main color segment 32). This is 2x21.5microsecond=43microsecond. However, as mentioned above, lengthening time only for 43 microseconds decreases the amount of the time which can be used for other bits conventionally modulated by the formula.
0025] Consequently, as shown in the lower table 2 as an example of an inclination, a synthetic fall of the optical uminous efficacy of a system may be caused. Table 2 shows the number of bits of a system which means the numbei of bits per [to each pixel] data sample. The concentration of NDF is the concentration of the NDF segment 34 in comparison with the concentration of the main color segment 32 assumed to be 1. For example, the concentration of he NDF segment 34 of 0.5 means that the concentration of the NDF segment 34 is 1/2 of the concentration of the ma color segment 32 of the color. In the case of the system of the bit of a certain number, as shown as "a bit in NDF", nore numbers than LSB displayed into 7 bit NDF segment of a system of LSB may be displayed.
0026] That is [LSB time is the limit to a system], since a system cannot have LSB below a certain amount of time, he amount of time is usually called LSB time, and the time to other bits is the multiple of LSB time. For example, in 7 bit system, MSB time is 64xLSB time. The amount of the time used for NDF segment of a color wheel is also neasured in Table 2.
0027]
Table 2]

ビット番号	ＮＤＦ濃度	ＮＤＦ内ビット	θ_{cs} のＮＤＦ％	LSB時間（μs）	光効率
7	適用外	0	適用外	43	0.81287
8	0.5	1 (0)	13.89%	43	0.8093
9	0.237	2 (0, 1)	13.85%	41.562	0.7672
10	0.105	3 (0, 1, 2)	15.97%	39.023	0.7095
10	0.0775	3 (0, 1, 2)	17.48%	38.364	0.6943
11	0.0775	4 (0, 1, 2, 3)	14.13%	30.282	0.6281
11	0.06	4 (0, 1, 2, 3).	15.09%	36.7066	0.6539

0028] Although it can obtain in order to display many bits from data's as shown in Table 2, in this example, LSB tim
ınd comprehensive light luminous efficacy are shortened, and fall. A fall of comprehensive light luminous efficacy
·educes the brightness which an image is perceived. Compaction of LSB time shown in this example may cause the
·esult which imposes a big loading on the data processing function and memory of an addressing system. However, u
)f these trade-ofves is a system-technology person's duty. The system of upper ** enables use to **** within a time
:onstraint of a space optical modulator of the bit of more numbers, and enables projection of the image which reduce
he artifact to the system of it.
0029] The timing used for these examples is simplified on the argument purpose. You have to take into a calculation
he special time of other required for an operation of a reset allowed time, the extra reset time for split bits, the specia
:lear time for short bits on the device which has a global-area reset, and not only a spoke allowed time but a modulat
:verythings at such time. Table 1 and the timing diagram of drawing 2 are not taking such time into a calculation for
he explanation of the whole design of this invention. However, the time given to Table 2 has taken such time into the
:alculation.
0030] Above-mentioned use of NDF is incorporable into other system architecture again. In a monochrome system,
ransparent wheel will be used instead of the upper color wheel. NDF field will be a certain predetermined shade of a
gray. It can come, and can come out, with more bits can be used now within a monochrome system.
0031] Furthermore, as for other examples, two space optical modulators and two color wheels exist here including 2
:hip system. One color wheel will have one color and the 2nd color wheel will have two colors. Each color will have
)eculiar NDF field. In 3 chip system, each space optical modulator may have a peculiar color wheel equipped with o
:olor and one NDF field. It may replace with this and all systems may have one wheel, and with a gray NDF field, th
wheel will be transparent and will have the tinction light source with each peculiar modulator in this case.
0032] these multiplex color wheel systems or a single ********** system -- setting -- things -- it is not **** if the
:olor wheel of profit must have NDF segment Since [the specific color longitudinal section of a system], one color
ıas NDF segment and other colors have the thing of **, such as not having this. Furthermore, although the above-
nentioned VCF is using the color wheel, the VCF of other form can also be used. for example, the liquid crystal
ıdjustable -- it can be used in order that NDF or a color controller may also control amplitude modulation
0033] Thus, although the system and technique of increasing the number of the bits in a display system were
explained about the specific example, it is wished to a claim shown above such a specific example does not think that
t is the limitation to the domain of this invention exceeding a publication.
0034] The following terms are further indicated about the above explanation.
0035] (1) The video dace ******** system containing the aforementioned VCF which it is a space optical modulato
s at least one VCF which passes the aforementioned light before the light from the light source which operates so tha
he aforementioned space optical modulator and the aforementioned space optical modulator which generate an imag
ıccording to deflection of the element of the shoes chosen of the arrays of each element may be illuminated, and the
ıforementioned light source irradiates the aforementioned space optical modulator, and contains a neutral
:oncentration field.
0036] (2) The system whose aforementioned space optical modulator is DMD in the system of the 1st-term
)ublication.
0037] (3) The system whose aforementioned space optical modulator is AMA in the system of the 1st-term

publication.
0038] (4) The system whose aforementioned space optical modulator is a liquid crystal device in the system of the 1st-term publication.
0039] (5) The system whose aforementioned VCF is a liquid crystal controller in the system of the 1st-term publication.
0040] (6) The system which operates in the system of the 5th-term publication so that the aforementioned liquid crystal controller may control a color.
0041] (7) The system which operates in the system of the 5th-term publication so that the aforementioned liquid crystal controller may control the value of NDF.
0042] (8) The system which is a system of the 1st-term publication and contains three space optical modulators and one color wheel.
0043] (9) The system which is a system of the 1st-term publication and contains three space optical modulators and three color wheels.
0044] (10) The system which is a system of the 1st-term publication and contains two space optical modulators and two color wheels.
0045] (11) How to contain [so that it may have pulse width equal to the step which displays the high order bit of the bits of a predetermined number per / which is the PDM technique used for generating an image, and has the conventional pulse width / data sample, and the thing to which the lower bit of the bits of the predetermined number t the above multiplied the conventional pulse width to this lower bit by the ratio of a VCF intensity and the predetermined low strength of NDF segment of the aforementioned VCF per data sample] the step which displays th aforementioned lower bit
0046] (12) Technique containing the step which displays the aforementioned lower bit displaying the one aforementioned lower bit of a 8 more bit system in the technique of the 11th-term publication.
0047] (13) Technique containing the step which displays the aforementioned lower bit displaying the two aforementioned lower bits of a 9 more bit system in the technique of the 11th-term publication.
0048] (14) Technique containing the step which displays the aforementioned lower bit displaying the three aforementioned lower bits of a 10 more bit system in the technique of the 11th-term publication.
0049] (15) Technique containing the step which displays the aforementioned lower bit displaying the four aforementioned lower bits of a 11 more bit system in the technique of the 11th-term publication.
0050] (16) Technique which is the technique of the 11th-term publication and is applied to a 5 bit system.
0051] (17) Technique which is the technique of the 11th-term publication and is applied to a 6 bit system.
0052] (18) Technique which is the technique of the 11th-term publication and is applied to a 7 bit system.
0053] (19) Technique which is the technique of the 11th-term publication and is applied to a 12 bit system.
0054] (20) The VCF wheel which contains at least one segment of the aforementioned wheel which has the aforementioned NDF VCF so that it may be the VCF wheel which operates so that it may be used for a video-display system and NDF segment may contain the field of the low strength of the aforementioned segment.
0055] (21) The system and technique of increasing the number of the bits which can be used for the use in the video display system containing at least one space optical modulator. The wheel 30 of three colors containing at least one segment 34 which has the low-strength field called NDF, or one transparent color wheel is used for the aforementione system. It may replace with this and a VCF may be a liquid crystal controller which controls either an optical amplitude or a color. By using a low-strength field, the amount of the time which can be used for processing LSB of a data sample is increased, and it removes the constraint to the number of bits which can be used for a display.

Translation done.]